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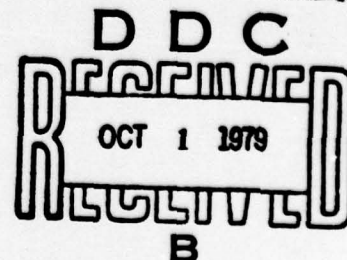
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Evaluating Planned Organizational Change:
A Proposed Method for the Assessment of
Alpha, Beta, and Gamma Change at the
Individual and Group Level

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Several papers recently have appeared on the topic of measuring planned organizational change with self-report data in Pre and Post designs. Such designs often are used in studies of organizational development, leadership training, and job enrichment where ratings on some variable of interest are taken both before and after the change. Golembiewski, Billingsley, and Yeager (1976), however, identified three conceptually different types of change that can occur with such self-report data, and they referred to these

as alpha, beta, and gamma change. They proposed a method for measuring
gamma change, but stated a need for methodologies to measure alpha and
beta change. Subsequent papers by Zmud and Armenakis (1978) and Lindell and
Drexler (1979) focused on the measurement of all three types of change.
The present paper critically reviews this work on alpha, beta, and gamma
change. Methodological problems, the need for large sample sizes, and the
use of only group level data are cited as disadvantages with the previously
proposed methods. Drawing on the current work of Howard et al. (1979) on
response shifts with self-report data, a method using profile analysis is
proposed that is capable of indexing all three types of change at both
group and individual levels of analysis. This method uses Pre ratings and
Post ratings, but also uses a retrospective "Then" rating. The retrospective
rating asks the participant to think back to how the situation was before
the change and to re-rate that situation in terms of the current situation.
It is documented that meaningful knowledge on the effects of change can at
times be understood best through comparison of the difference between the
Post and the retrospective Then ratings rather than through comparison of
the difference between Pre and Post ratings. Advantages and limitations
with the proposed technology are discussed. It is thought that this new
method has potential for reconciling conflicting results in self-report
change studies such as in the job enrichment area where objective job
changes are not always documented with self-report Pre and Post ratings of
job dimensions.

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Evaluating Planned Organizational Change: A Proposed

Method for the Assessment of Alpha, Beta, and Gamma

Change at the Individual and Group Level

Abstract

Three conceptually different types of change that can occur with self-report

data were identified by Golembiewski, Billingsley, and Yeager (1976). Past

research on this topic is critically reviewed and a new technique is proposed

that is capable of indexing all three types of change at both individual and

group levels of analysis.

The accurate measurement of change is crucial when longitudinal designs

are used to study impacts of interventions. Statistical problems associated

with the general measurement of change have been discussed (c.f., Harris, 1963;

Cornbach & Furby, 1970). Golembiewski, Billingsley, and Yeager (1976), however,

identified a different set of problems with the measurement of change when

self-report data are used as criteria in studies of organizational development

(OD), leadership training, and job enrichment where Pre and Post ratings are

obtained from participants. They proposed that three conceptually different

types of change can occur, and they called these types alpha, beta, and gamma

change. Offering a method for assessing gamma change, the authors stated a

need for methodologies to assess alpha and beta change. Since the Golembiewski

et al. (1976) paper, Zmud and Armenakis (1978) and Lindell and Drexler (1979)

have commented on methods for assessing all three types of change.

In this paper we will discuss problems with the proposed methodologies

and will offer a new approach for assessing alpha, beta, and gamma change. We

will begin with the three definitions of change offered by Golembiewski et al.

(1976). We then will briefly discuss the Zmud and Armenakis (1978) and the

Lindell and Drexler (1979) papers with regard to the measurement of alpha and beta change. The conclusion of this section will deal with problems in the measurement of gamma change. In the next section, we will discuss a body of new research that introduces innovations that have the potential for the measurement of beta change. This research focuses on response-shift bias in self-report data. The third section of the paper will contain discussions of: a method for the assessment of beta change at the individual level that uses profile analysis; a method for the assessment of gamma change; a method for the aggregation of individual change data such that group level change can be examined; and some limitations with the proposed methods.

Review of the Problem and Previously Suggested Solutions

Golembiewski et al., in their discussion of Pre and Post intervention self-report data, defined alpha, beta, and gamma change as follows: "Alpha change involves a variation in the level of some existential state, given a constantly calibrated measuring instrument related to a constant conceptual domain. Beta change involves a variation in the level of some existential state, complicated by the fact that some intervals of the measurement continuum associated with a constant conceptual domain have been recalibrated. Gamma change involves a re-definition or reconceptualization of some domain, a major change in the perspective or frame of reference within which phenomena are perceived and classified, in what is taken to be relevant in some slice of reality", (1976, pp. 134-135). With regard to self-report data, alpha change represents an unbiased measure of variation in some state between Time 1 (T_1) and Time 2 (T_2) where the participant's report of change is taken on a constantly calibrated instrument. Beta change refers to an observed variation in some state where the apparent change is due to an instrument that has been recalibrated by the participant between T_1 and T_2 assessments. This threat to internal validity has been called instrumentation by Campbell and Stanley (1963). To the extent that beta change has occurred,

comparisons of Pre and Post intervention measures will present a biased measure
of the intervention. That is, observed differences between Pre and Post measures
reflect an unknown amount of true change and an unknown amount of change due to
instrumentation. Gamma change refers to a redefinition or reconceptualization
by the participant of the phenomenon that is measured between T_1 and T_2 assess-
ments. To the extent that gamma change has occurred, it may be misleading to
compare differences in Pre and Post intervention self-report data. As an illus-
tration of the three types of change, suppose that leader supportiveness is
measured on a 20 point scale and that the mean on the Pre measure is 13 whereas
the mean on the Post measure is 14 (assume that higher scores indicate increased
supportiveness). Golembiewski et al. (1976) suggest that this change of one unit
could reflect an actual although slight increase in supportiveness, which would
be alpha change; an unknown amount of change in either direction if the scale
values have been recalibrated such as due to a change in the positive or negative
end points used by participants when making a response, which would be beta change;
or a change in the participants' conceptualization of the construct of leader
supportiveness, which would be gamma change. Furthermore, it is possible that
more than one type of change could occur as a result of an intervention.
Obviously, it is important to understand which type of change has occurred if the
effects of interventions are to be unambiguously examined. In the sections that
follow, limitations with previously proposed methods for determining which type
of change has occurred will be reviewed.

Zmud and Armenakis (1978) suggested that alpha and beta change can be differ-
entiated when Pre and Post ratings are collected both on actual criterion levels
and ideal criterion levels. Through comparison of actual scores, ideal scores,
and differences between actual and ideal scores, they maintain it is possible to
infer alpha or beta change, assuming no gamma change. Basically, the logic is
that if ideal scores have changed, then participants have recalibrated the

measurement scale. Examination of difference scores will clarify whether only

beta change has occurred or if both alpha and beta change have occurred.

There are several problems with this method. First, just because Post

intervention scores suggest that the actual is now closer to the ideal, it does

not mean that the intervention has had the intended effect. If the measurement

scale has been recalibrated, i.e., beta change, we do not know if a Pre inter-

vention difference of 10 points can be compared to a Post intervention difference

of 6 points. Due to possible recalibration of scale end points or of intervals

between the end points, the Post intervention difference may indicate movement

toward the ideal, away from the ideal, or no movement at all. Second, because

participants are likely to indicate that the ideal belongs toward the positive

end of the scale, it may be difficult to obtain a statistically significant dif-

ference between ideal scores due to a ceiling effect. This statistical problem

is important because according to Zmud and Armenakis (1978), beta change cannot

be detected unless there first is a difference between ideal scores. Finally,

these same authors suggested that examination of actual scores and difference

scores would indicate whether alpha change, beta change or both have occurred.

Wall and Payne (1973), however, have shown that the use of such scores trans-

lates to a situation where there almost always has to be a negative relationship

between actual scores and difference scores. This method also assumes that a

difference score of 2 points, for example, has the same meaning regardless of

whether it exists at the positive or negative end of the scale. Imparato (1972)

has shown that this assumption is probably incorrect.

These reasons, in addition to several others mentioned by Zmud and Armenakis

(1978), limit the utility of actual, ideal, and difference scores for the deter-

mination of whether alpha and beta change have occurred, and for the assessment

of the impact of the intervention.

Lindell and Drexler (1979) also commented on the Golembiewski et al. (1976)

paper and questioned the severity of the beta change problem. They argue that if beta change occurs when intervals of the measurement continuum have been re-calibrated, then the solution is to use psychometrically reliable scales consisting of multiple items with behavioral anchors. This will reduce the likelihood of instrumentation bias, or beta change, from occurring. According to Lindell and Drexler, the problem of beta change is avoided when psychometrically sound scales are employed.

We question this conclusion. Lindell and Drexler (1979) did not offer a method for assessing beta change should it exist. Rather, they defined beta change as a non-problem when appropriate scales are used. But, without a technique for assessing beta change, there is no empirical way to test Lindell and Drexler's assertion. Although we agree with the importance of psychometrically sound rating scales, proof by assertion in the absence of data is not an acceptable method for resolving problems with beta change. Furthermore, in a later section we will present data that we believe show the occurrence of beta change even when scales of the type recommended by Lindell and Drexler are used. We also note that Golembiewski, et al. essentially are saying that with regard to beta change, there is no such thing as a truly "psychometrically sound" scale.

We now will turn to gamma change. Gamma change refers to a reconceptualization of the phenomenon as a result of the intervention. Golembiewski et al. (1976) demonstrated that gamma change might be indicated through comparison of factor structures over time. Suppose that assessments are taken at T_1, T_2, and T_3 and that the intervention occurred between T_2 and T_3. If gamma change occurred and beta change did not, then coefficients of congruence between T_1 and T_2 factor structures should be high whereas coefficients of congruence between T_1 and T_3 and between T_2 and T_3 factor structures should be substantially reduced. If there is high congruence among all pairs of factor structures, then gamma change is not thought to have occurred.

Again, we believe that there are problems with this method for assessing

gamma change even though Zmud and Armenakis (1979) endorsed the factor congruency approach. First, the method assumes that beta change did not occur. In the absence of a technique for assessing beta change, the use of this factor analytic method for assessing gamma change is extremely questionable. Lindell and Drexler (1979) raised a second problem. They correctly argued that either alpha or beta change for a subset of subjects could produce changes in factor structures. Consequently, we may incorrectly conclude that gamma change has occurred when the change in factor structures was due to alpha or beta change. Third, there is at present no statistical test that allows for the determination of reliable differences in coefficients of congruence. Finally, factor analysis and similar multivariate procedures require that the ratio of participants to items be at least as large as 3:1 for any type of reliability to be obtained. This ratio is a liberal rule of thumb. The implication of this is that factor analysis can not be used in studies where few participants are involved compared to the number of items in the scale. Although some OD related interventions involve large numbers of participants, Porras and Berg (1978) found that 46% of the studies they reviewed had N's of 100 or less and that 58% of the studies focused on the individual as the level of analysis. Thus, the use of factor analysis is limited even if it were appropriate from a statistical viewpoint.

It also may be useful to raise a new issue that concerns the level of analysis at which change is measured. Implicit in the papers of Golembiewski et al. (1976), Zmud and Armenakis (1978) and Lindell and Drexler (1979) is the examination of change through differences in group means or factor structures. Control groups or baseline data are used for this purpose of comparison. We propose that in addition to knowledge of group differences, it is important to assess individual change at the level of the individual. Although we realize that this limits anonymity of responses, lack of attention to individual change may confuse interpretation of group effects. First, relatively large changes in means for a

few individuals could lead to the conclusion that the intervention had a group
effect and was successful. But, in reality the intervention was only partially
successful. Thus, later measurement of group process and outcome data may reflect
little change even though self-report group level data suggest that a change has
taken place. Second, in groups composed of organizational members from different
levels of the organization, it may be important to know among which members a
change occurred. If changes occurred only among key members, then this may be
reflected in other group level process and outcome changes. Third, examination
of change at the individual level will allow for determination of differential
effects due to the intervention. Some people may show beta change whereas others
may show gamma change. Group level data would mask these differential effects.
Finally, knowledge of individual change may be more useful in feedback discussions
of survey data. This would allow for a more focused examination and comprehension
of the effects of the intervention. Although problems exist with the aggregation
of data and the examination of group effects is important, reliance only on group
level data may be misleading.

<u>Research on Response Shift Bias</u>

In a series of 12 studies, Howard and his colleagues (Howard, et al., 1979;
Howard & Dailey, 1979; Howard, Schmeck & Bray, 1979; Howard, Dailey & Gulanick,
Note 1; Howard, Millham, Slaten & O'Donnell, Note 2; and Bray & Howard, Note 3)
have demonstrated that experimental interventions that employ self-report measures
of Pre and Post intervention ratings are subject to an <u>instrumentation</u>-related
source of contamination known as <u>response-shift bias</u>. The difficulty arises
when the experimental intervention changes the subject's evaluation standard
with regard to the dimension measured using the self-report instrument. The
definition of response-shift bias is similar to the Golembiewski et al. (1976)
conception of beta change, and Howard et al. (1979) note that when response-
shifts occur, even true experimental designs (Campbell & Stanley, 1963) are

incapable of providing an unbiased estimate of treatment effects, i.e., alpha change.

An example of a response-shift might prove enlightening. A workshop participant might believe at pretest that she is an "average" leader. But, the intervention expands her conception of the range in leadership effectiveness that can occur. Consequently, at posttest she believes that her pretest level of functioning was really "below average". If she now rates herself as "average" at posttest we might erroneously conclude that the workshop had no effect.

In all investigations conducted by Howard and his colleagues to date, response-shifts have served to increase the accuracy of subjects' ability to rate themselves after the intervention. Subjects report increased insight into their real level of functioning and state that this resulted from their intervention experiences. Subjects reliably conclude at posttest that their pre-intervention ratings were inaccurate.

Howard and his colleagues recommend that at the post-intervention session subjects be asked to respond to each item on the self-report measure twice. First they are to report how they perceive themselves to be at present. This corresponds to the usual post-intervention assessment. Immediately after answering each item in this manner, they are to answer the same item again, only this time in reference to how they now perceive themselves to have been just before the workshop was conducted. This new assessment has been labeled the "Then" measure by Howard. The difference between Pre and Then self-report ratings is called the response-shift. Howard et al. (1979) suggest that changes in treatment subjects' standards of measurement are responsible for response-shift effects. Because Then and Post ratings are made in close proximity, if Howard et al. (1979) are correct, it is more likely that both ratings will be made from the same perspective, and thus be free of response-shift bias or beta change.

When considering the impact of response-shift bias and the use of retro-

spective measures to attenuate this source of bias, two issues become salient.
First, does the Then/Post approach provide a substantially different set of
conclusions about the effectiveness of an intervention than does the traditional
self-report Pre/Post approach? Several studies by Howard and his colleagues
revealed significant Then/Post treatment effects whereas Pre/Post analysis produced
nonsignificant results. There have been no instances where Pre/Post analyses pro-
duced significant results while Then/Post analyses produced nonsignificant results.
However, differing conclusions about the value of interventions are not always the
case. Ralph (1975; Pilot Studies 1 and 2) reported nonsignificant intervention
effects whether Pre/Post or Then/Post self-report ratings were employed, whereas
significant self-reported intervention effects were found by Howard, Schmeck, and
Bray (1979); Howard and Dailey (1979); and Howard, Dailey, and Gulanick (Note 1)
using both the Pre/Post and Then/Post approaches. Therefore, in five of the eleven
studies to date where direct comparisons between Pre/Post and Then/Post approaches
could be made, the Then/Post analysis yielded a drastically different set of con-
clusions regarding the effectiveness of the intervention from the Pre/Post approach.

A second issue to be considered is which method provides the more valid
results. In five separate analyses of the impact of intervention procedures rang-
ing across assertiveness training, interview skills training, helping skills
training, and interpersonal effectiveness training (Howard et al., 1979; Howard
& Dailey, 1979; Howard, Dailey & Gulanick, Note 1), the results from the Then/
Post measurement approach were more similar to objective ratings of change in
subject behavior and performance than were the results obtained from traditional
Pre/Post self-report methods. In a study investigating actual changes in amount
of material acquired in a college course, Then/Post self-reports of content
learned reflected more accurately the students' actual mastery than did the Pre/
Post self-report approach (Howard, Schmeck & Bray, 1979). In estimating parti-
cipants' change in an assertiveness workshop, Then/Post ratings were more in

agreement with the facilitator's ratings of changes than was the Pre-Post self-
report approach (Howard, Millham, Slaten & O'Donnell, Note 2). Finally, Bray
and Howard (Note 3) evaluated a workshop designed to improve the teaching skills
of a group of teachers. The correlation of Then/Post ratings of change with
changes from before to after the workshop in independent judges' ratings of the
teachers' skills was significantly higher than the correlation of teachers'
Pre/Post self-ratings of change with the changes in the judges' ratings. Overall,
in no study comparing Then/Post and Pre/Post self-report methods was the Pre/Post
measure superior or even equivalent to the Then/Post approach in reflecting
behavioral indices of change.

An investigation of several potential concerns about the adequacy of
retrospective pre-intervention measures has been undertaken. Perhaps, at the
time of the posttest, subjects have a distorted memory of their pre-intervention
level of functioning and Pre/Then differences are due simply to systematic
memory biases. Study 5 of Howard et al. considered this possibility in the
evaluation of a semester-long communication skills training program. Immed-
iately after completing Post and Then self-report ratings, subjects were
asked to recall their Pre scores (Memory). Mean memory ratings were virtually
identical to Pre ratings, but significantly different from the Then scores,
suggesting that the response-shift reflects something more than mere systematic
memory distortions. Subsequent interviews with subjects revealed that many
had an uncanny recollection of their pre-intervention responses and that they
now saw their pre-test responses as inaccurate reflections of their pre-
intervention level of functioning. Subjects were typically aware that their
retrospective ratings provided a differing picture of their pre-intervention
levels of functioning than their self-report pre-intervention responses, and
volunteered explanations of why they believed their pre-ratings to be inaccurate.
Similar findings regarding memory distortion effects were also reported by

Howard and Dailey (1979).

A related concern is the effect of retrospective Then ratings on Post ratings. Theoretically, there is little rationale for why the Post rating should be altered by asking for the Then rating, but it is a potential methodological issue. Two studies were conducted that examined the effect of Then ratings on Post ratings (Howard et al., 1979; Howard, Daily and Gulanick, Note 1). Subjects given the same intervention treatment were asked at posttest to provide Post ratings or Post and Then ratings. The results of both studies indicated that Post ratings were unaffected by asking for a Then rating.

Response-style biases may be another factor that could limit the utility of retrospective Then ratings. One might hypothesize that the potential for this contamination is heightened when a subject is asked to provide both pre-intervention and post-intervention ratings of his/her level of functioning at one point in time. To examine this question, Howard, Millham, Slaten and O'Donnell (Note 2) investigated the operation of social desirability and impression management response bias on retrospective measures of assertiveness. The correlations of social desirability scores with pre-intervention self-reports of assertiveness were higher than those obtained between social desirability and retrospective self-reports on the same measure. It would appear, within the context of the intervention procedures employed in the Howard, Millham, Slaten and O'Donnell (Note 2) study, that social desirability responding was actually diminished when utilizing the retrospective methodology. Additionally, a bogus pipeline procedure was employed for half of the treatment subjects in this study. Bogus pipelines are techniques wherein subjects are led to believe that the experimenter is able to determine the veracity of their self-report responses. Millham and Kellogg (in press) have demonstrated that differences between scores obtained under bogus and non-bogus pipeline conditions reflect the operation of impression management and hence should be indicative of attempts to meet implicit task demands to demonstrate

improvement to the evaluator. The shifts in self-report measures of pre-
intervention states that occur using the retrospective methodology were found
to be no different when obtained under bogus pipeline and under non-bogus pipe-
line conditions. The results did not support the hypothesis of greater bias,
and, in fact, were consistent with an interpretation of reduced bias, on retro-
spective measures. Obviously, further studies in this domain are needed.
However, it should be noted that continued findings demonstrating that eval-
uations using retrospective ratings show greater concurrent validity with
objective and behavioral indices than traditional self-report approaches might
render the contamination issue moot.

Finally, it is our belief that the scales used to assess Pre, Post and
Then measures in the studies by Howard and his colleagues had psychometric
features recommended by Lindell and Drexler (1979). Recall that Lindell and
Drexler stated that beta change would be unlikely to occur when psychometrically
sound scales with behavioral anchors are used to obtain Pre and Post ratings.
This appears not to be the case.

Method for Assessing Alpha, Beta, and Gamma Change: A Proposal

This section will begin with a brief discussion of the methodological impli-
cations of the work by Howard and his colleagues on the response-shift. Next,
we will present methodologies for assessing alpha, beta, and gamma change at the
level of the individual. Finally, we will conclude with suggested approaches for
aggregating individual level change data to group level change data such that
comparisons between intervention and control groups can be made.

The methodological implications of the work by Howard and his colleagues
for assessing group level alpha and beta change are rather straightforward. Pre
measures are taken before the intervention and both Post and retrospective Then
measures are taken after the intervention. Comparable Pre, Post, and Then measures
are obtained from a control group. If the group mean on the Pre measure is differ-

ent from the group mean on the Then measure for the intervention group while no difference between these measures is found for the control group, it is concluded that beta change has occurred in the intervention group. Alpha change is then defined as the difference between Post and Then group means. When no evidence of beta change is found, alpha change could be assessed by comparing both Pre and Post measures and Post and Then measures. It should be noted that Howard's research suggests that even when there are no significant differences between Pre and Then measures, the correlations between Post and Then score differences and objective measures of change are greater than correlations between Post and Pre score differences and objective measures of change. This does not mean, however, that Pre ratings no longer need to be collected. Pre ratings are necessary for the identification of beta change and, as will be shown later, for the identification of gamma change. Rather, unless there is strong reason to suspect Then scores, Howard simply recommends that greater reliance be placed on results from Post and Then self-report measures in studies of change. But, at present there is no reason to suspect Then scores except in situations where it is to the participants' obvious advantage to give false Then responses, where participants are confused as to the instructions, or where participants in a no-treatment control group are asked to give Post and Then ratings within a few hours or days of the Pre ratings.

Whereas Howard's procedure for studying the response shift and for assessing alpha and beta change represents a considerable improvement over the suggested approaches of Zmud and Armenakis (1978) and Lindell and Drexler (1979), a different approach based upon profile analysis offers an alternative that may be preferable, primarily because it focuses attention on the individual. Also, the work of Howard and his colleagues has not to date considered gamma change or its measurement. We propose that alpha, beta, and gamma changes can be described at the individual and the group level with Pre, Post, and Then ratings that are examined using profile analysis.

Profile analysis is a method for examining differences between two patterns

of scores on the same set of items or scales. Various forms of profile analysis
have been used in such diverse areas as the classification of people as schizo-
phrenic or normal (Klett & Pumroy, 1972) and the classification of organizations
as Systems I, II, III or IV (Likert, 1967).

A basic issue in profile analysis concerns the appropriate method for deter-
mination of the degree to which two profiles are similar or dissimilar. Nunnally
(1978) states that pairs of profiles can be compared according to their level,
their shape, and their dispersion. Level refers to the mean of scores on all
items in the profile. Two profiles are similar in level if the mean of item
scores in one profile is not significantly different from the mean of item scores
in the other profile. Two profiles are similar in shape if the correlations
between the two profiles are positive and statistically significant from zero.
Finally, two profiles are similar in dispersion if the standard deviation of
item scores in one profile is not significantly different from the standard devia-
tion of item scores in the other profile. Confusion over the interpretation of
similarity exists because two profiles can have: (1) similar levels yet be of
dissimilar or even opposite shapes; (2) different levels but similar shapes; or
(3) similar levels and shapes but different dispersions. These examples are only
three of many combinations that could occur and graphic representations of these
three possibilities are presented in Table 1.

Insert Table 1 about here

We propose that alpha, beta, and gamma change for any individual in an
intervention or control group can be identified and measured through the selective
comparison of profiles for Pre, Post, and Then ratings made by that individual
to a set of items that make up a single construct or dimension. We will discuss
beta change first. Once the existence of beta change at the level of the indi-

vidual has been determined, the assessment of alpha change is relatively straight-forward. We will conclude with a discussion of gamma change.

Howard's work suggests that a retrospective Then measure taken at the same time as the Post measure should be on the same recalibrated scale as the Post measure. Consequently, any recalibration by an individual due to beta change should primarily affect the level of that individual's profile and not the shape or dispersion. Strictly speaking, this assumes that beta change has occurred to a similar extent for every item in the unidimensional scale. This may be impossible to determine, but in practice it should not be a concern if, and this is important, multiple items are used to assess the same underlying dimension. Therefore, beta change would be reflected by a difference between an individual's mean score across all items on the Pre measure and his/her mean score across all items on the Then measure. A dependent t-test where the N is based on the number of items or scale scores in the profile provides a descriptive index of the beta change for the individual. It may be unwise, however, to refer the observed t-value to a table of critical values in a t-distribution in an attempt to assess the significance of change for the individual because the assumption of independence of observations is violated, that is, all measures come from the same individual. We will discuss the implications of this violation in a later section. In any event, the t-value for the individual provides a useful description of change at the individual level and can also serve as an index number through which group level change can be investigated, as will be discussed later. Alpha change can be examined in a similar manner by calculating a dependent t-value between profile means for the Post and the Then measures for an individual. Again, this value should be judged descriptively, because of the violation of the assumption of independence.

It might be useful to pause here and reflect on how to interpret the results of an inferential test statistic in a descriptive and not inferential

manner. We are hesitant to encourage overinterpretation of the proposed methodology.
Because violations of test statistic assumptions are of unknown consequence for
the biasedness of the test, we do not believe that obtained probability values should
be taken at face value. Such caution, however, does not irrevocably reduce the
utility of such tests. Probability values are one kind of aid to interpretation
and there is nothing sacrosanct about the .05 level. A correlation of r = .03
based on a sample of 100,000 may be statistically significant yet descriptively
speaking it describes a weak relationship. Similarly, if we find a t-value of 6.50
for the difference in a person's Post and Then profile means and a t-value of .05
for the difference in the same person's Pre and Then profile means, then descrip-
tively speaking there appears to be much greater evidence of alpha change than beta
change. We would prefer to be able to offer unbiased inferential test statistics;
however, being unable to discover any such tests, we are willing to trust the
researcher to examine the data and to openly discuss and interpret the results.
Such descriptive reporting is not without precedence and is often used in N=1
multiple baseline studies on learning and behavior change.

Determination of individual level gamma change is less straightforward than
for alpha or beta change. Nevertheless, we believe it is possible to specify the
conditions that would be indicative of gamma change. Golembiewski et al. (1976)
proposed that gamma change would be reflected by a lack of congruence between
factor structures of ratings taken before and after the intervention. Factor
structures are based upon the pattern of correlations or the pattern of covariances
among variables. We propose that gamma change can be identified through examina-
tion of profile shapes, i.e., correlations, and profile dispersions, i.e., variances
or standard deviations. This is accomplished through pairwise profile analysis
of Pre, Post, and Then ratings to a set of items that are thought to measure a
single construct or dimension. An example will demonstrate how we propose to
infer gamma change at the individual level. First, correlations between profiles

are computed for a participant's Pre and Post measures, Pre and Then measures, and Post and Then measures. If gamma change has occurred, the correlation between Post and Then measures should be substantially greater than the correlations between Pre and Post measures and Pre and Then measures. In other words, the participant perceives the shape of the profile or the degree to which particular items tend to "go-together" differently after the intervention has occurred. The subject has reconceptualized the dimension under investigation. Thus, comparison of correlations among Pre, Post and Then profile shapes represents one descriptive definition of the existence of gamma change. How similar or dissimilar the correlations must be before the researcher concludes gamma change is difficult to specify. It would be possible to use the Hotelling-Williams statistic (Darlington, 1975) as a descriptive aid, but this statistic requires considerable computational effort. Again, we must trust that the results are openly presented and that reasonable judgment is taken.

A second operationalization of gamma change involves comparison of profile dispersions. We propose that standard deviations of the items in the profiles for Pre, Post, and Then scores be examined for differences in dispersion. If the standard deviations of Post and Then profiles are not different from each other but if each is different from the standard deviation of the Pre profile, we propose that this change in dispersion is another form of evidence for a reconceptualization of the dimension under investigation. An inferential test for differences in non-independent variances is not widely known but a test statistic does exist (Kirk, 1978, p. 277). Again, however, the resulting statistic must be judged descriptively because of the lack of independence.

Finally, a third operationalization of gamma change would consider the degree to which both profile shapes and dispersions have changed as a result of the intervention. That is, it is possible that profiles could differ in shape but not dispersion, dispersion but not shape, or both shape and dispersion. We propose that the third, and perhaps strongest, description of gamma change be defined as when substantial differences exist for both shapes and dispersions.

The above guidelines for the identification of individual level gamma change are abstract not by choice, but by the lack of appropriate test statistics. Also, many combinations other than what we have described could exist. For example, correlations between all pairs of profiles could be substantially different from each other. We have attempted to define the types of relationships that should exist if gamma change is thought to have occurred. To the extent that these specific relationships are not found, then the likelihood of gamma change is diminished. At a minimum, the proposed methodologies at least suggest how the researcher might study alpha, beta, and gamma change at the level of the individual. No other methodologies have even considered these three types of change at this level of analysis.

As was stated earlier, it would be desirable to be able to use the recommended methods for the analysis of group level change data in addition to the analysis of individual change data. This would be especially valuable when participants are assigned to intervention versus control groups or to different levels or types of interventions. We now turn to a discussion of how individual data might be aggregated to produce evidence of group level change.

First, let us consider the examination of alpha change. Given the existence of beta change, alpha change at the individual level is determined through analysis of Post and Then scores. One method of arriving at a significance test to assess group level alpha change would be to follow the procedure used by Howard. In Howard's approach an index number for each participant is calculated as the difference between the mean Post and the mean Then score for that person. An analysis of variance (or a t-test in the case of two groups) is then performed, comparing the mean index scores of different groups of individuals. Although this approach is reasonable, an alternative approach makes direct use of the t-values calculated for each individual as was outlined in the section on individual level alpha change. Using the t-value as an index number, each person in the inter-

vention group will have a t-value as will each person in the control group. These t-values can be used as the dependent variable in a comparison of the difference between the two groups. A Mann-Whitney U test (two groups) or a Kruskal-Wallis H test (more than two groups) can then be conducted on the ranked t-scores. A statistical difference between intervention and control groups with greater t-values in the intervention group would suggest that the intervention had an effect. Such a nonparametric procedure is preferred because the t-values for individuals should probably be considered as ordinal rather than as interval data. The advantages of this approach over Howard's are that it makes direct use of individual t-values and that the inclusion of a standard deviation term in the denominator when the t-value is computed controls for differential contraction or expansion of the response scale for that individual. Furthermore, in contrast to individual level alpha change, the nonparametric procedure can be interpreted as an inferential test statistic, i.e., the probability value is unbiased.

Group level beta change would be examined in a similar manner. A Mann-Whitney U test or a Kruskal-Wallis H test would be conducted on the ranked t-values that were associated with each individual's comparison of Pre and Then profile means. Recall that alpha change considered Post and Then profile means.

Finally, examination of group level gamma change would proceed in a similar manner as was used for group level alpha and beta change. Only in this case, the scores or index numbers that would be ranked for analysis with the Mann-Whitney U test or the Kruskal-Wallis H test are constructed from differences in pairs of profile correlations or pairs of profile standard deviations. Taking profile correlations first, we propose that the researcher compute correlations between each pair of Pre, Post, and Then profiles for each participant in both the intervention and control groups. Thus, each individual has three correlations; one for Pre/Post, one for Pre/Then, and one for Post/Then. Recall that these correlations were computed for individual level gamma change. Next, the raw differ-

ence score between each pair of correlations is computed. If gamma change has occurred as a result of the intervention, then for people in the intervention group the correlation between Pre/Post profiles should be similar to the correlation between Pre/Then profiles, i.e., a small difference score. But, the correlation between Post/Then profiles should be greater, i.e., a large difference score, than the other two correlations ($\underline{r}_{Post,Then} > \underline{r}_{Pre,Post} = \underline{r}_{Pre,Then}$). For people in the control group, all three correlations should be similar in magnitude ($\underline{r}_{Post,Then} = \underline{r}_{Pre,Post} = \underline{r}_{Pre,Then}$). In the case of two groups, a Mann-Whitney U test of group differences would be computed three times, once on the ranked difference scores of $\underline{r}_{Post,Then}$ minus $\underline{r}_{Pre,Post}$; once on the ranked difference scores of $\underline{r}_{Post,Then}$ minus $\underline{r}_{Pre,Then}$; and once on the ranked difference scores of $\underline{r}_{Pre,Post}$ minus $\underline{r}_{Pre,Then}$. If gamma change had occurred to people in the intervention group but not to people in the control group, then significant Mann-Whitney U's should be found between groups on Post/Then minus Pre/Post and Post/Then minus Pre/Then correlation differences. But, there should be no group effect for differences between Pre/Post minus Pre/Then correlation score differences. In other words, gamma change predicts that Post/Then profile correlations should be larger than Pre/Post or Pre/Then profile correlations and that the latter two correlations should not be different from each other. The Mann-Whitney U test looks at the rank order of differences between correlations as a function of intervention versus control group membership.

Examination of group level gamma change using profile dispersions would require that for each individual the raw difference score between standard deviations for Pre, Post, and Then profiles be computed ($Post_{S.D.}$ minus $Then_{S.D.}$; $Post_{S.D.}$ minus $Pre_{S.D.}$; and $Then_{S.D.}$ minus $Pre_{S.D.}$). If the scale is unidimensional at Pre-test but multidimensional at Post-test, then the standard deviations of Post and Then profiles should be larger than the standard deviation of the Pre profile. This requires that at the time of analysis all items in the scale be scored so that a high, or low, response value for each item reflects a response in the same direction.

The next step is to do three Mann-Whitney U tests for participants in both intervention and control groups; once for the ranked difference scores using Post-Then standard deviations, once for the ranked difference scores using Post-Pre standard deviations, and once for the ranked difference scores using Then-Pre standard deviations. Gamma change in the intervention group but not in the control group would be reflected by a significant Mann-Whitney U for Post-Pre and Then-Pre ranked differences. In other words, people in the intervention group should have large differences between Post-Pre and Then-Pre standard deviations while people in the control group should have small differences on these profiles. For both sets of difference scores, i.e., profile correlations and profile standard deviations, the probability values of the Mann-Whitney U tests can be interpreted at face value. As with individual level gamma change, we propose that the strongest demonstration of gamma change be defined as when predictions for group differences in profile shapes and profile dispersions are both supported.

Limitations and Advantages

Although our proposed methods alleviate many of the problems associated with other methods, there are necessarily limitations to our approach. First, given our methodology, it is impossible to perform meaningful significance tests at the individual level. The t-values proposed here are meant to provide a descriptive measure of the degree of change for a particular individual, instead of providing for statistical inference. An inferential test here would require the assumption that items on the scale be independent of one another. To the extent that this assumption is violated, significance tests for an individual are potentially quite misleading, because the assumption of independence of observations is crucial for the t-test (see, for example, Scheffe', 1959). Although the proposed approach does not provide significance tests at the individual level, none of the methods proposed by previous investigators even considered a description of change at the level of the individual. Our method at least served to direct attention toward

the individual as well as toward the individual's group.

Fortunately, the assumption of independence is unnecessary for assessing the three types of change at the group level. Although t-values and difference scores form the dependent variables in these group analyses, the significance tests employed here do not depend upon the sampling distributions of the individual level statistics. We add, however, the observation that computation of a difference score assumes that the numbers used to compute the difference score are themselves interval in nature. This clearly is not the case. Thus, it is possible that difference scores computed from raw correlations could result in different Mann-Whitney U values than difference scores computed from correlations that were first transformed to z-scores. In this instance, we could have suggested the use of the Hotelling-Williams statistic (see Darlington, 1975) but, the mathematical advantages of this test do not merit, in our opinion, the extreme computational effort involved.

One further assumption, however, is important for assessing gamma change at either the group or individual level. As previously stated, it is assumed that items on the scale being used to measure change are unidimensional. To understand the necessity of this assumption, suppose that different items on one scale in fact measured two different constructs, and that beta change (but no alpha or gamma change) occurred for items measuring one construct but no change of any type occurred for the other construct. In this case, the Then and Post profiles will correlate highly but the Pre and Then as well as the Pre and Post will not. However, this is exactly the pattern of correlations that reflects gamma change. Thus, in this situation, what appears to be gamma change by our method is actually beta change for a subset of the constructs being measured by the scale. On the other hand, if the scale truly is unidimensional, this pattern of correlations can arise only because of gamma change. Viewed in this light, gamma change occurs when a person's self-perceptions are changing, but changing in different

manners for different items.

A final limitation is that by investigating three types of change at the group level, a large number of significance tests are being conducted. The use of an alpha level of .05, for example, for each significance test in a study would result in the probability of at least one Type 1 error somewhere in the study being much greater than .05. However, the fact that the three types of change are conceptually distinct argues that each separate test could be conceptualized as addressing a distinct hypothesis, so that the proliferation of tests is not necessarily a problem. If the cost of Type 1 errors is judged to be severe, a conservative approach using the Bonferroni method of adjusting the alpha level for each test could be employed.

Whereas the previous discussion outlined the unresolved issues in this pro- posed approach to the measurement of change (or any other existant approach), there are at least five decided advantages to the approach presented in this paper. First, the analyses are <u>both</u> ideographic and nomothetic in nature. Profile analyses are performed on the data of individual subjects. Therefore, differing types of change can be demonstrated by different individuals. This is in marked contrast to the previous approaches to the measurement of change. The data can later be combined for nomothetic analyses, but the first step is ideographic.

A second advantage, which is related to the ideographic analysis, is that feedback regarding the effectiveness of the intervention can be tailored to the individual. That is, we might inform one individual that he/she had experienced a beta change whereas the majority of the group experienced an alpha change. In doing so we might improve the validity and usefulness of our feedback efforts. Individually tailored feedback might be more appropriate for subsequent discussions of implications, suggestions for future interventions and the like.

A third advantage involves the ability of the proposed method to deal with interventions on small samples of subjects. Conceptually, a sample size of one

could be handled by this approach, which is in marked contrast with the factor
analytic approaches that require large numbers of subjects relative to the number
of self-report items employed to be considered reliable. This advantage is espe-
cially important in OD-type interventions where reduced sample-sizes are typically
the rule.

Fourth, unlike previous attempts to understand change, the present proposal
allows investigators to look at the three types of change in a more independent
manner. Any possible permutation of none, some, or all three types of change can
be found and described for each individual subject in the study.

The last advantage we note is related to this ability to independently assess
the three types of change, that is, researchers are now able to obtain a much more
sophisticated understanding of exactly what effects their intervention produced.
If alpha change occurred in a few subjects and beta change in a different subset of
individuals, researchers might consider related issues, such as amount of time with
the organization or pre-intervention level of skill on the target dimensions as
clues regarding why the intervention had differential impacts on subgroups of par-
ticipants. Analyses such as these will result in a more multidimensional, sophis-
ticated and precise understanding of what the intervention did and did not accomplish.

There are additional consequences of the adoption of the present approach
which cannot really be called advantages although they might be advantageous in some
instances. Researchers are forced to closely examine their raw data rather than re-
lying on group means based on scores that are summed over items. The change agent
must have a sound knowledge of the constructs/behaviors that are to be the focus of
the intervention prior to the intervention itself. That is, he/she needs a thorough
knowledge of the various scale dimensions and constructs. Also, it is important
that dimensions and constructs be assessed with multiple items where each item has
several response alternatives. Because t-values and correlations are computed on a
person's profile scores, a profile consisting of only five items with each item
having only four response alternatives could produce misleading results. A minor

change on one item would have a greater impact on computed profile correlations when five items are used as opposed to say 10 or 15 items. Similarly, a minor change on one item with four response alternatives would have a greater impact than a minor change with 20 response alternatives. Note that the survey developed by Likert (1967) uses 20 response alternatives. Additionally, whereas the amount of testing time is likely to be about 10% greater when Post and Then measures are collected as opposed to Post measures only, we believe this additional time and thought are well spent because the subject is required to focus directly upon the phenomenon of change.

Finally, we believe that the present approach can be extended to time series data, although there is some question as to how to operationalize retrospective Then scores. For illustration purposes, suppose that observations are collected at four different time periods (T_1, T_2, T_3, and T_4) and that the intervention occurs between T_2 and T_3. Ratings are also collected from a control group. Measures of the current status of the phenomenon would be collected at each observation and these could be called Pre_1, Pre_2, $Post_1$, and $Post_2$ using current terminology. Retrospective Then questions would be asked at T_2, T_3, and T_4. There are two ways to ask the retrospective Then question, however, and at present we have no data on which method is to be preferred. One method would ask the participant to rate the phenomenon in reference to how they currently perceive it to have been at the time of the last observation. In other words, the first Then question refers to T_1, and the second and third Then questions refer to T_2 and T_3. Here, we would predict that there would be no evidence at alpha, beta, or gamma change at either the individual or group levels for data collected at T_1 and T_2. But, if the intervention had an effect, then evidence of this should be seen in comparison of T_2 and T_3 ratings. Consideration of T_3 and T_4 ratings becomes less clear as to what to expect. People in the control group should essentially provide similar Pre, Post and Then ratings throughout all time periods. But, because some interventions are designed to provide the participant with the capacity for continued change, then alpha, beta,

and gamma change could be observed between T_2 and T_3 and even between T_3 and T_4. That is, the intervention may have both an immediate and a continued effect on the rate and type of change experienced by the participant. We propose that the three types of change be examined for all adjoining pairs of ratings, regardless of the time span between ratings. Through examination of individual and group results, it should be possible for the researcher to describe and understand the short and long term effects of the intervention. As with any time-series design, however, the computational work involved requires increasing effort as more data are collected. Also, the ability to describe and understand change as conceptualized by Golembiewski et al. (1976) and as operationalized here may become even more complex.

The second operationalization of the Then rating would ask the participant to rate the phenomenon in reference to how they currently perceive it to have been at the time of the first, and not the most recent, observation. In other words, Then ratings at T_2, T_3, and T_4 all would reflect back to T_1. With this approach, any pair of ratings and not only adjoining pairs could be analyzed as described earlier.

We hesitate to continue with a discussion of the proposed methodology as applied to time series designs because we have not collected data with such designs and conjecture at this point may prove misleading. But, we heartily endorse future research on this extension because retrospective Then ratings have been shown to be valid for periods of up to one year after the intervention (Howard et al., 1979). Thus, the use of such ratings may be informative on planned change that spans several years.

Concluding Remarks

A short decade ago Cronbach and Furby (1970) asked how we should measure change--or should we? Their conclusion was that the measurement of change was a complex and problematic endeavor, and that alternatives to measuring change, such as through comparison of post intervention scores only, be seriously considered whenever possible. The work of Golembiewski and Howard and their colleagues points

out that with self-report data, the measurement of change is far more complex
and problematic than even Cronbach and Furby led us to believe. Unfortunately,
it now is apparent that Cronbach's and Furby's recommended solutions to measuring
change are inappropriate with self-report data (Howard, Schmeck & Bray, 1979;
Golembiewski et al., 1976), and we are forced again to measure change. This
paper proposes a thorough and systematic technique for assessing change at the
level of the individual that is cognizant of our increased sophistication regard-
ing the ways in which change presents itself and our acquired knowledge of meas-
urement techniques over the past decade. Once again, we find that human beings
are complex and cognitive beings. Our suggestions are intended to enable us to
appreciate further human change in its complexities.

Footnote

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Table I: Examples of Profile Levels, Shapes, and Dispersions

	Example 1	Example 2	Example 3
	Scale Values	Scale Values	Scale Values
Item Number	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
1			
2			
3			
4			
⋮			
N-1			
N			
Profile Level	Similar	Different	Similar
Profile Shape	Different	Similar	Similar
Profile Dispersion	Similar	Similar	Different

Profile A -------

Profile B _____

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